

A SURVEY AND RECENT DEVELOPMENTS OF LUNAR GRAVITY ASSIST*

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ABSTRACT

Earth's moon is the largest in the solar system relative to its parent body, the Earth, and can have significant effect on the path of a spacecraft flying close by. This effect, when planned to benefit a specific mission, is called lunar gravity assist (LGA), and assumes that one aims the spacecraft towards the Moon in such a way that the Moon's gravitational pull will alter the spacecraft's course in a favorable manner.

The first application of LGA was in the Apollo program, where the command and lunar modules (and astronauts) were propelled to the Moon such that, if no additional course changes were made, they would swing around the backside of the Moon at a certain altitude and be flung back to Earth to enter the atmosphere at a specified location in the Pacific ocean. This LGA was an essential element saving the lives of the astronauts on Apollo 13.

This paper will illustrate the basic mechanics of gravity assist, and list the many applications where it has been used effectively over the past 30 some years. These include missions to the sun and Earth libration points, redirecting a spacecraft from one of these point to a comet encounter, and enhancing payloads by providing an energy boost by the Moon.

More recently, studies and actual missions have shown the benefits of LGA in: (1) assisting lunar capture, (2) repositioning geosynchronous communications satellites, (3) boosting spacecraft to Earth escape and departure to planets and other solar system bodies, and (4) allowing small spacecraft to be launched as secondary payloads and released into almost a random orbit from which each may depart and maneuver in space with gravity assists from the Earth and Moon to perform a specific planetary or other mission. This latter application is a recent development by the author and is being applied in 2002 and later years, with piggyback flights on the Ariane 5 which launches comsats to GEO.

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